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10/062,716	02/05/2002	Kil Ho Kim	041501-5477	3108

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EXAMINER

GUERRERO, MARIA F

ART UNIT PAPER NUMBER

2822

DATE MAILED: 07/15/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/062,716

Applicant(s)

KIM, KIL HO

Examiner

Maria Guerrero

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 05 February 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-19 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some \* c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other:

**DETAILED ACTION**

1. This Office Action is the First Action on the merits.

Claims 1-19 are pending.

***Priority***

2. Receipt is acknowledged of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

***Specification***

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required: the hard mask having a gradual slope within an inner portion of the first region.

***Claim Objections***

4. Claim 1 is objected to because of the following informalities: the recitation "forming a hard mask to remove a portion of the first hard mask material" on line 9; it is considered to be an inconsistent terminology. It is suggested to replace "forming a hard mask" by -forming a mask-. Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

5. Claim 15 is rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. While the specification provide support for "etching the inter-metal dielectric using a plasma including a first activated CaFb + CxHyFz....", the specification does not provide support for the limitation "wherein the inter-metal dielectric is formed by using a plasma including a first activated CaFb + CxHyFz...." Clarification is requested.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

6. Claims 4, 8-9, and 13 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "minimum thickness" in claims 4, 8-9, and 13 is a relative term which renders the claims indefinite. The term " minimum thickness " is not defined by the claims, the specification does not provide a standard for ascertaining the requisite

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degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. There is not specific thickness range disclosed.

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

7. Claims 1, 5, 7, 14, and 18-19 are rejected under 35 U.S.C. 102(b) as being anticipated by Grill et al. (U.S. 6,140,226).

Grill et al. teaches forming an inter-metal dielectric including a first region and a second region on a semiconductor substrate (Fig. 3A, col. 4, lines 1-5, col. 5, lines 43-45). Grill et al. shows sequentially forming a diffusion barrier film, and inter-metal dielectric and the first hard mask on a semiconductor substrate having a lower metallic line formed within an insulating layer (Fig. 1A-1C, col. 4, lines 1-10, col. 5, lines 34-45). In addition, Grill et al. discloses forming a first hard mask material layer on the entire surface of the inter-metal dielectric, removing the first hard mask material layer on the first region, and forming a second hard mask material layer on an entire surface of the inter-metal dielectric (Fig. 3B, 4A-4B, col. 5, lines 45-55).

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Furthermore, Grill et al. teaches forming a mask to remove a portion of the first hard mask material layer on the second region and etching the inter-metal dielectric of the first region to a first thickness using the mask (Fig. 4B-4C, col. 6, lines 3-33, 42-55). Grill et al. discloses exposing the inter-metal dielectric of the second region, the first hard mask material on the second region is simultaneously removed when the second hard mask material layer on the first region is etched, and etching the exposed inter-metal dielectric to simultaneously form a via hole and a trench having the via hole (Fig. 4C-4D, col. 6, lines 45-55). Grill et al. teaches removing the second hard mask material and depositing a metallic material within the via hole to form a plug and an upper metal line (Fig. 1K-1L, col. 6, lines 53-55, col. 9, lines 9-12). Grill et al. shows the hard mask material being Ti, TiN, Ta, TaN, and W (col. 5, lines 53-56).

8. Claims 1-2, 4-6, 8-9, 13, and 15-17 are rejected under 35 U.S.C. 102(e) as being anticipated by Chang et al. (U.S. 6,365,506).

Chang et al. teaches forming an inter-metal dielectric (low dielectric constant material) including a first region and a second region on a semiconductor substrate (Fig. 3A). Chang et al. discloses forming a first hard mask material layer on the entire surface of the inter-metal dielectric, removing the first hard mask material layer on the first region, and forming a second hard mask material layer on an entire surface of the inter-metal dielectric (Fig. 3B-3C).

Furthermore, Chang et al. teaches forming a mask to remove a portion of the first hard mask material layer on the second region and etching the inter-metal dielectric of the first region to a first thickness using the mask (Fig. 3D-3F). Chang et al. discloses

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exposing the inter-metal dielectric of the second region, and etching the exposed to simultaneously form a via hole and a trench having the via hole, the via hole having a positive slope and the mask having a gradual slope within an inner portion of the first region (3B-3G).

In addition, Chang et al. shows sequentially forming a diffusion barrier film, and inter-metal dielectric and the first hard mask on a semiconductor substrate having a lower metallic line formed within an insulating layer (col. 1, lines 30-65, col. 3, lines 30-40). Chang et al. teaches employing  $\text{Ar}/\text{CF}_4/\text{CHF}_3$  etch chemistry (col. 3, lines 58-67). Chang et al. shows employing a photoresist to remove only the second hard mask material layer on the first region and employing a photoresist to remove only the first hard mask material layer on the second region (Fig. 3C-3F).

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Grill et al. (U.S. 6,140,226) in view of Yang et al. (U.S. 6,162,587).

Regarding claim 10, Grill et al. does not specifically show employing  $\text{Cl}_2$  and  $\text{BCl}_3$  or  $\text{SF}_6$  on the etching process. However, Yang et al. teaches employing  $\text{Cl}_2$  and  $\text{BCl}_3$  to

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etch Ta TaN Ti, or Tin (col. 9, lines 33-40). Yang et al. also shows employing SF<sub>6</sub> to etch tungsten (W) (col. 9, lines 18-25).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to include the gas taught by Yang et al. in Grill et al. reference in order to improve the selectivity during the etching process (Yang et al., col. 9, lines 25-30).

10. Claims 11-12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Grill et al. (U.S. 6,140,226) in view of Lee et al. (U.S. 6,300,238).

Regarding claims 11-12, Grill et al. does not specifically show the second hard mask material having a curved spacer shaped surface. However, Lee et al. shows employing the hard mask material having a curved spacer shaped surface (Fig. 1D, 2D, col. 1, lines 58-61 col. 3, lines 25-35).

Regarding claim 12, it would have been obvious to a person of ordinary skill in the art at the time of the invention to recognize that the thickness of the first and second hard mask materials can be the same according to the drawings (Grill et al., Fig. 3D, 4A).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Grill et al. reference by including curved spacer shaped surface as taught Lee et al. in order to avoid damage (Lee et al., col. 4, lines 5-6).

11. Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chang et al. (U.S. 6,365,506) in view of Tang (U.S. 6,143,649).



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Regarding claim 3, Chang et al. does not specifically show employing a gradual slope. However, Tang shows using a gradual slope in order to achieve acceptable contact step coverage (col. 1, lines 25-28, 50-60, col. 2, lines 45-60).

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Chang et al. reference by including the gradual slope taught by Tang in order to provide better contact step coverage (Tang, col. 1, lines 25-28).

### ***Conclusion***


12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Hong (U.S. 6,573,176) (same Assignee) teaches a method for forming dual damascene line structure. Morrow et al. (U.S. 6,479,391) and Usami (U.S. 6,468,898) show a method for making a dual damascene interconnect using a multilayer hard mask.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maria Guerrero whose telephone number is 703-305-0162.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Amir Zarabian can be reached on 703-308-4905. The fax phone numbers for the organization where this application or proceeding is assigned are 703-308-7722 for regular communications and 703-308-7724 for After Final communications.

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Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

  
Maria Guerrero  
Patent Examiner  
July 8, 2003